THE SMALL PLANT OPERATOR AS SCIENTIST[1]

By Abel Wolman[2]

To many small plant operators the title of this discussion may appear objectionable, for there still exists a vague distrust of the term "science." In most cases, a scientific worker or a scientific paper is synonymous with long words, difficult concepts, impractical ideas, and a certain aloofness of attitude. On the other hand, the so-called practical man stands with both feet on earth, talks American English, and presents facts that are workable and intelligible to the man who operates the pumps or fires the boiler. Is it not rather impertinent, therefore, to link these two conflicting spirits in the title chosen?

The author's task is to indicate that the absurdity of the contrast between "practical" and "scientific" is more apparent than real. This task has been chosen advisedly, since, by eliminating a certain amount of antagonism engendered by terms, it may be possible to bring about in the water works field a more fruitful use of the vast array of facts which the small plant operator has accumulated and will continue to collect.

Karl Pearson in the "Grammar of Science"[3] defines the function of science as "the classification of facts, the recognition of their sequence and relative significance." Stripped of its classical verbiage, the function of science is no more than the function of every technical practical operator, namely, the observation and interpretation of facts. It is important to emphasize that "a scientific frame of mind is not a peculiarity of the professional scientist."[3] And it is just as important to point out that, because scientific reports are often couched in English too elegant to be clear, it is not therefore true that science is a mere matter of language. It follows then that,

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[3] "The Grammar of Science," Karl Pearson; Part I, Physical; page 13. Adam and Charles Black, London, 1911.

if an operator sees facts and reasons as to their cause and effect, he becomes a scientific observer. The author is sorry to destroy, in this way, the illusion of some listeners that they, thank Heaven! are practical men and not theorists. He makes the charge that each man in this audience is a scientific worker, provided he is in possession of all his mental faculties. We must establish for ourselves, therefore, the axiom that practice and theory are not antithetical, but complementary.

A little thought will make clear that all plant operators may be divided into three classes, the first, who feel that they are scientific but hesitate to present their observations because of inherent modesty; the second, the practical, who observe but do not report because of a supposed lack of scientific language; and the third, who neither observe nor report. This last class is, it is hoped, numerically small and need not concern us. The first two classes have much in common, both as to method and result. It is to these two classes that one must look for real development in water treatment, since they are the first to encounter new problems and the first to try out new solutions. A scientific hypothesis is useless if it is not in accord with the facts everywhere. A scientific solution is worthless if it does not solve our problems. Both the hypothesis and the solution must be tested by the plant operator. He is an important factor in real scientific progress. How important, he has evidently failed to realize, if we judge from the infrequency with which he takes part in discussions of theory and hypothesis.

When we speak of a problem in water treatment, we are prone to emphasize its simplicity rather than its complexity. We find it easy to fall into the error of considering "water" as a definite thing, a simple compound, instead of regarding it always as a most variable substance, delicately fluctuating with atmospheric, geographic, and geologic influences. When water is considered in this sense, each water filtration plant becomes a laboratory, a scientific structure, a research bureau, where facts and opinions may and should be tested out upon the peculiar and rare fluid there being handled. When a new hypothesis is announced, each plant operator has the opportunity to make a real contribution to science and to practice by determining if it tallies with the phenomena experienced with his own rarity, the little stream used in his plant. Likewise, he has the continual advantage of learning whether older theories account for the present observations and whether older methods are adequate.

Each small plant stands, therefore, in the position of a special research laboratory, upon the director of which there has been placed the duty of watching and interpreting a continuous series of experiments performed under conditions common to no other laboratory. The author would emphasize the distinctiveness of each plant, since even on the same stream, a few miles apart, the water has undergone profound change which converts it into a new substance, with new, though possible slightly varied, attributes.

If we accept the concept of each plant as a true specialized investigative bureau and of water as a variable and not a constant substance, what operator has the right to say that he is not or should not be a scientific observer? His duty, whether he likes it or not, has been enlarged from that of valve-operator to investigator. His responsibility is greater than to his immediate community, it is national and even international. For the plant operator is now research worker, and the fruits of research are limited only by the infinite.

It is clear from the above discussion that in each plant, no matter how small, no matter how crude, phenomena of great importance and of peculiar significance are occurring and recurring. They are not always observed and still less often are they reported. It is the special plea of this paper to-day that this condition be remedied, for with its remedy, perhaps, many men, both scientists and practical men, will avoid voyages "bound nowhere, under full sail."

In concluding these remarks, the author has recourse once more to a quotation from the "Grammar of Science," which presents so much better than he can the argument for the reporting of facts and opinions by the small plant operator.

> It is as if individual workers in both Europe and American were bringing their stones to one great building and piling them on and cementing them together without regard to any general plan or to their individual neighbor's work; only where some one has placed a great corner stone is it regarded, and the building then rises on this firmer foundation more rapidly than at other points, till it reaches a height at which it is stopped for want of a side support. Yet this great structure, the proportions of which are beyond the ken of any individual man, possesses a symmetry and unity of its own, notwithstanding its haphazard mode of construction. This symmetry and unity lie in scientific method. The smallest group of facts, if properly classified and logically dealt with, will form a stone which has its proper place in the great building of knowledge, wholly independent of the individual workman who has shaped it. Even when two men work unwittingly at the same stone they will but modify and correct each other's angles.